APPENDIX B

DRINKING WATER SUPPLY RESERVOIRS AND ALGAE

Algae in drinking water reservoirs cause problems for drinking water supplies which appear to be due to the release of organic chemicals from algal cells either during normal metabolic processes or following rupture of algal cells after the algae die. The most common of these problems are taste and odor and the potential for increased formation of trihalomethanes (THMs) and fortunately, much less common are incidences of human illness.

Taste and Odor Problems

Undoubtedly, all drinking water supplies using surface water sources occasionally have taste and odor problems in their finished water. Among suppliers using reservoirs, City Utilities of Springfield (1,2,3,4) has probably done the most monitoring and analysis in an attempt to understand and manage taste and odor as a predictable element of reservoir limnological process. Their studies, in the simplest possible terms, indicate that more nitrogen and phosphorus result in greater amounts of algae in the reservoir and that more algae in the reservoir results in more taste and odor problem with the water.

There is probably a certain amount of taste and odor producing organic chemicals in drinking water from all surface sources at all times. Deciding when the concentration of these chemicals in the raw water becomes high enough to constitute use impairment in the finished water is extremely difficult. Records of taste and odor complaints kept by City Utilities of Springfield indicate that they receive a small number of complaints frequently, often when algal levels in the reservoirs are low. They get higher numbers of complaints corresponding to some occasions of higher levels of algae in lakes; they have noted two occasions in the last 15 years of every noticeable taste and odor in the water and large numbers of complaints.

Detection of taste and odor is subjective and can vary greatly between individuals. Accurate quantitative measurements are difficult so that use impairment decisions should reflect the perceptions of the water consumers, and ideally would have to take into account answers to the following questions?

1. For each individual, is there a tolerable taste and odor threshold above which the use is impaired?

2. What percent of consumers must have taste and odor impairment before the waterbody is classified as "use impaired ?

3. What percent of the time must consumers have taste and odor impairment before the waterbody is classified as "use impaired ?

4. How do we get accurate answers to the three questions above?

Recommendation:

At this point, the Water Pollution Control Program feels it has no good method of determining whether or not use impairment of a drinking water reservoir is occurring due to taste and odor problems. The proposed method of use attainment determination is, in the absence of frequent, exceptional occurrences of taste and odor problems in a particular water supply, is to recognize that all reservoirs produce algae and, therefore, some level of taste and odor, which is usually treatable to acceptable levels by most consumers, thereby meeting the beneficial use criteria. Reservoirs supplying water which have evidence of taste and odor problems significantly greater than the norm for Missouri supplies drawn from surface waters, would be rated as less than full use attainment and would be placed on the 303(d) list.

In recognition that taste and odor problems do occur in virtually all public drinking water reservoirs in the state, and to help address this concern, the state Section 319 nonpoint source watershed prioritization list will give high priority to nonpoint source projects that focus on improved management of fertilizer, animal manure or other nitrogen and phosphorus nonpoint sources in public drinking water supply watersheds.

Illness

Organic chemicals produced by algae and released to the environment can not only cause taste and odor problems but also produce a toxic effect in humans. A study of the cause of gastroenteritis in some residents of Lamar, Missouri, concluded that organic chemicals released from algal cells in the drinking water reservoir had caused the problem.

Because occasional relatively heavy algal growths are common on reservoirs throughout the state, this problem may occur elsewhere, but to date, no documentation of a similar problem is known in any other Missouri drinking water reservoir.

For the purpose of defining use impairment of a drinking water reservoir due to illness in water consumers, the following guidance is suggested: if evidence suggests at least one incident of human illness due to algal toxins within the drinking water supply reservoir within the past five years, the reservoir will be judged to be not supporting its drinking water source beneficial use, and will be placed on the 303(d) list, otherwise the reservoir will be judged to be in full attainment of this use.

References

1. Personal Communication, David Ballou, Springfield City Utilities, Sept. 29, 1997.
2. Youngsteadt, N. 1986. McDaniel Lake Phytoplankton Response to Nutrient Manipulation. City Utilities of Springfield, Missouri.
3. Youngsteadt, N. 1995. Trophic State Trends in McDaniel - Fellows Watershed, 1983-94. City Utilities of Springfield, Missouri.
4. Youngsteadt, N. 1994. McDaniel - Fellows Watershed Data, 1982-1992. City Utilities of Springfield, Missouri.